Radiative forcing due to warm-moist air intrusion into the Antarctic

Takashi Yamanouchi[1] and Naohiko Hirasawa[1, 2]
[1]*National Institute of Polar Research*
[2]*Graduate University for Advanced Studies*

At Ny-Ålesund, Svalbard, we have seen that warm-moist air intrusion contributed to the Arctic warming through downward longwave radiation by clouds and water vapor (Yamanouchi, 2018). Now, the role of radiative forcing due to warm-moist air intrusion in the Antarctic is an item of discussion. Already, abrupt warming at Antarctic inland Dome Fuji Station was found to be brought by warm-moist air intrusion associated with wintertime blocking (Hirasawa et al., 2000). It is of great interest to know the difference in the function of intrusion in the Arctic and Antarctic, due to the contrast between Arctic amplification and warming suppression in East Antarctica and the contribution to the precipitation and accumulation.

Fig. 1 shows the downward, upward and net longwave radiative fluxes, cloud amount and surface air temperature at Syowa Station during one month, July 2015. Also shown (right) are hisograms of downward and net longwave ratiation. In the figure, most pronounced feature is the abrupt warming more than 30°C, from nearly -40°C on 14 July to nearly 0°C on 18 July, and accompanied increase of the downward longwave radiation (LD) from about 120 W/m^2 to 300 W/m^2. This 180 W/m^2 increase in the LD was derived by clouds and water vapor together with warm and moist air intrusion. Looking at the 500 hPa geopotential height field, it is clearly seen that Syowa Station is located within polar vortex between 12 and 14 July, but is located outside the polar vortex on 18 July, and indicating intrusion of ridge – lower latitude air mass. Contrary to the results in Ny-Ålesund, Svalbard, low LD with cold teperature around 12 and 15 July is not a basis and continued only for a few days. Rather, higher LD between 150 to 250 W/m^2, around 200 W/m^2, is much common, just as seen in the histogram.

As writen in the beginning, similar phenomenon was already noticed in June 1997, when LD was also measured at Dome Fuji Station, and showed a great increse from about 80 W/m^2 to 200 W/m^2, and lower amount in LD around or less than 100 W/m^2 was common during this month. So, the situation was very similar to the result at Ny-Ålesund, Svalbard, and only the high amount of LD was realized by the intrusion of warm-moist air. At the same month at Syowa Station, LD was much variable and this specific intrusion did not indicate such a special phenomena as at Dome Fuji Station.

We have not reached to the conclusion yet, and still needs also to discuss about the water vapor intrusion – precipitation and accumulation, such as done by Gorodetsukaya et al. (2014), Welker et al. (2014) and so on.

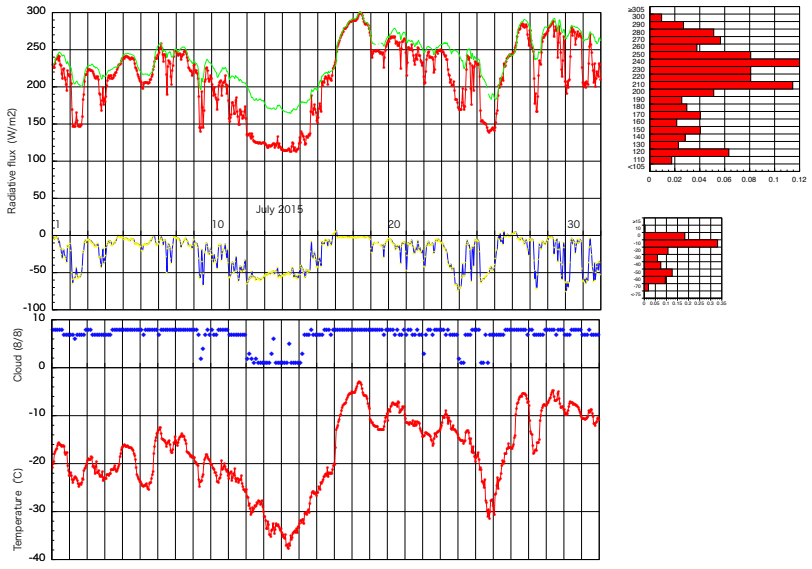

Fig. 1 Downward, upward and net longwave radiative fluxes (from BSRN), cloud amount and surface air temperature (left), and (right) hisograms of downward and net longwave ratiation at Syowa Station, July 2015.

References

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